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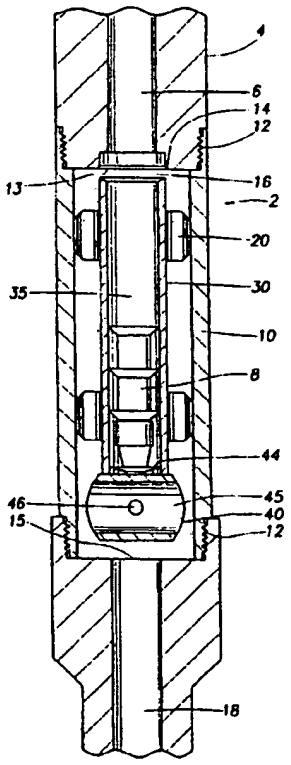
(54) Abstract Title: **Plug-dropping container for releasing a plug into a wellbore**

(57) The plug-dropping container (2) comprises an elongated housing (10), and a canister (30) disposed co-axially within the housing. The canister (30) is movable from a lower position to an upper position. In its lower position, a fluid bypass area (16) is defined above the canister. When a dart (8) is retained within the canister, fluid is diverted through the bypass (16) and around the canister (30) within an annular area defined between the canister and the housing (10). In one aspect, the canister (30) is moved by rotation of a plug-retaining device (40) below the canister. In its plug-retained position, the plug-retaining device is oriented so that the wall (44) of the plug-retaining device blocks the downward path of the dart (8). In the plug-released position, the plug-retaining device (40) raises the canister (30) to its upper position, substantially shutting off the bypass (16). A channel (45) in the plug-retaining device is thus aligned with a channel (35) in the canister for receiving the plug, and for release into the wellbore (18).



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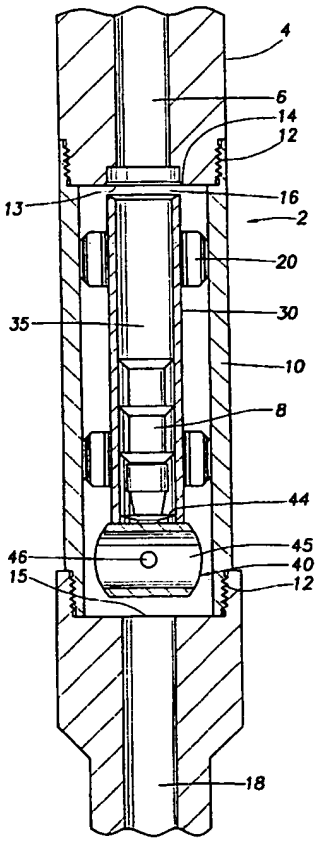
(54) Title: PLUG-DROPPING CONTAINER FOR RELEASING A PLUG INTO A WELLBORE



(57) Abstract: The plug-dropping container (2) comprises an elongated housing (10), and a canister (30) disposed co-axially within the housing. The canister (30) is movable from a lower position to an upper position. In its lower position, a fluid bypass area (16) is defined above the canister. When a dart (8) is retained within the canister, fluid is diverted through the bypass (16) and around the canister (30) within an annular area defined between the canister and the housing (10). In one aspect, the canister (30) is moved by rotation of a plug retaining device (40) below the canister. In its plug-retained position, the plug-retaining device is oriented so that the wall (44) of the plug-retaining device blocks the downward path of the dart (8). In the plug-released position, the plug-retaining device (40) raises the canister (30) to its upper position, substantially shutting off the bypass (16). A channel (45) in the plug-retaining device is thus aligned with a channel (35) in the canister for receiving the plug, and for release into the wellbore (18).

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PLUG-DROPPING CONTAINER FOR RELEASING A PLUG INTO A WELLBORE

The present invention generally relates to an apparatus for dropping plugs into a wellbore. More particularly, the invention relates to a plug-dropping container for releasing plugs and other objects into a wellbore, such as during cementing operations.

In the drilling of oil and gas wells, a wellbore is formed using a drill bit that is urged downwardly at a lower end of a drill string. After drilling a predetermined depth, the drill string and bit are removed and the wellbore is lined with a string of casing. An annular area is thus formed between the string of casing and the formation. A cementing operation is then conducted in order to fill the annular area with cement. The combination of cement and casing strengthens the wellbore and facilitates the isolation of certain areas of the formation behind the casing for the production of hydrocarbons.

It is common to employ more than one string of casing in a wellbore. In this respect, a first string of casing is set in the wellbore when the well is drilled to a first designated depth. The first string of casing is hung from the surface, and then cement is circulated into the annulus behind the casing. The well is then drilled to a second designated depth, and a second string of casing, or liner, is run into the well. The second string is set at a depth such that the upper portion of the second string of casing overlaps the lower portion of the first string of casing. The second liner string is then fixed or "hung" off of the existing casing. Afterwards, the second casing string is also cemented. This process is typically repeated with additional liner strings until the well has been drilled to total depth. In this manner, wells are typically formed with two or more strings of casing of an ever-decreasing diameter.

In the process of forming a wellbore, it is sometimes desirable to utilize various plugs. Plugs typically define an elongated elastomeric body used to separate fluids pumped into a wellbore. Plugs are commonly used, for example, during the cementing operations for a liner.

The process of cementing a liner into a wellbore typically involves the use of liner wiper plugs and drill-pipe darts. A liner wiper plug is typically located inside the top of a liner, and is lowered into the wellbore with the liner at the bottom of a working string. The liner wiper plug has radial wipers to contact and wipe the inside of the liner as the plug travels down the liner. The liner wiper plug has a cylindrical bore through it to allow passage of fluids.

After a sufficient volume of circulating fluid or cement has been placed into the wellbore, a drill pipe dart or pump-down plug, is deployed. Using drilling mud, cement, or other displacement fluid, the dart is pumped into the working string. As the dart travels downhole, it seats against the liner wiper plug, closing off the internal bore through the liner wiper plug. Hydraulic pressure above the dart forces the dart and the wiper plug to dislodge from the bottom of the working string and to be pumped down the liner together. This forces the circulating fluid or cement that is ahead of the wiper plug and dart to travel down the liner and out into the liner annulus.

Typically, darts used during a cementing operation are held at the surface by plug-dropping containers. The plug-dropping container is incorporated into the cementing head above the wellbore. Fluid is directed to bypass the plug within the container until it is ready for release, at which time the fluid is directed to flow behind the plug and force it downhole. Existing plug-dropping containers, such as cementing heads, utilize a variety of designs for allowing fluid to bypass the plug before it is released. One design used is an externally plumbed bypass connected to the bore body of the container. The external bypass directs the fluid to enter the bore at a point below the plug position. When the plug is ready for release, an external valve is actuated to direct the fluid to enter the bore at a point above the plug, thereby releasing the plug into the wellbore.

Another commonly used design is an internal bypass system having a second bore in the main body of the cementing head. In this design, fluid is directed to flow into the

bypass until a plug is ready for release. Thereafter, an internal valve is actuated and the flow is directed on to the plug.

There are disadvantages to both the external and internal bypass plug container systems. Externally plumbed bypasses are bulky because of the external manifold used for directing fluid. Because it is often necessary to rotate or reciprocate the plug container, or cementing head, during operation, it is desirable to maintain a compact plug container without unnecessary projections extending from the bore body. As for the internal bypass, an internal bypass requires costly machining and an internal valve to direct fluid flow. Additionally, the internal valve is subject to erosion by cement and drilling fluid.

In another arrangement, a canister containing a plug is placed inside the bore of the plug container. The canister initially sits on a plunger. Fluid is allowed to bypass the canister and plunger until the plug is ready for release. Upon release from the plunger, the canister is forced downward by gravity and/or fluid flow and lands on a seat. The seat is designed to stop the fluid from flowing around the canister and to redirect the flow in to the canister in order to release the plug. However, this design does not utilize a positive release mechanism wherein the plug is released directly. If the cement and debris is not cleaned out of the bore, downward movement of the canister is impeded. This, in turn, will prevent the canister from landing on the seat so as to close off the bypass. If the bypass is not closed off, the fluid is not redirected through the canister to force the plug into the wellbore. As a result, the plug is retained in the canister even though the canister is "released."

The release mechanism in some of the container designs described above involves a threaded plunger that extends out from the bore body of the container, and requires many turns to release the plug. The plunger adds to the bulkiness of the container and increases the possibility of damage to the head member of the plug container. Furthermore, cross-holes are machined in the main body for plunger attachment. Because a plug container typically carries a heavy load due to the large amount of

tubular joints hanging below it, it is desirable to minimize the size of the cross-holes because of their adverse effect on the tensile strength of the container.

Therefore, there is a need for a more effective plug-dropping apparatus for a cementing head. There is a further need for a cementing head that can efficiently release a plug into a wellbore. There is still a further need for a plug releasing apparatus that is more compact, easier to handle, and less expensive to manufacture.

In accordance with one aspect of the present invention there is provided a plug-dropping container within a head member for releasing an object into a wellbore, the plug-dropping container comprising:

a tubular housing;

a canister disposed within and generally aligned with said tubular housing so as to define an annulus between said tubular housing and said canister, said canister being movable axially within said housing from a lower position to an upper position;

a channel within said canister, said canister channel being configured to receive the object therein;

a bypass proximate to the top end of said canister for permitting fluid to flow into said annulus when said canister is in its lower position, said bypass being substantially shut off when said canister is raised to its upper position within said housing;

a plug-retaining device disposed within said tubular housing below said canister, said plug-retaining device having a first end, a second end, and a wall therebetween;

a channel within said plug-retaining device for placing said first and second ends of said plug-retaining device in fluid communication;

and wherein said plug-retaining device is movable from an object-retained position to an object-released position, such that said wall of said plug-retaining device substantially blocks the object from exiting said canister when said plug-retaining device is in its object-retained position, and said channel of said plug-retaining device is in substantial alignment with said channel of said canister when said plug-retaining

device is in its object-released position, thereby permitting the object to exit said canister and to travel downward through said channel of said plug-retaining device.

Further aspects and preferred features are set out in claim 2 *et seq.*

The present invention, at least in its preferred embodiments, generally relates to a plug-dropping container for use in a wellbore circulating system. An example of such a system is a cementing operation for a liner string. The plug-dropping container comprises a tubular housing having a top end and a bottom end. The top end may be in sealed fluid communication with a wellbore fluid circulation device. Thus, fluid injected into the cementing head will travel through the housing before being injected into the wellbore.

The plug-dropping container also comprises a canister disposed co-axially within the housing. An annulus is thus defined between the canister and the surrounding housing. The canister is likewise tubular in shape so as to provide a fluid channel therein. The canister also has a top opening and a bottom opening. However, the canister is configured so that it is movable axially within the housing. A bypass gap is left between the top opening of the canister and the bore of the head member. In one aspect of the invention, the bypass gap is created by configuring the length of the canister to be less than the length of the surrounding housing.

The canister is axially movable within the housing. In this respect, the canister can be moved axially within the housing from a lower position to an upper position. In its lower position, fluid is permitted to flow from the bore of the head member, through the bypass gap, and into the annular area around the canister. Fluid may thus bypass the channel within the canister. However, raising the canister to its upper position within the housing causes the top opening to approach the bore of the cementing head. This effectively shuts off the bypass gap, thereby forcing fluid to be injected into the wellbore through the canister channel.

The plug-dropping container is used to retain one or more plugs such as a drill pipe dart for a cementing operation. In this respect, the channel of the canister is configured to closely receive the dart. While the dart is retained within the canister, the canister is in its lower position. This permits fluid to travel around the canister and the dart therein. When the dart is to be dropped into the wellbore, the canister is raised so as to substantially shut off fluid flow through the bypass gap. This forces fluid to flow into the channel of the canister. Fluid pressure builds behind the dart, forcing it out of the canister.

The plug-dropping container finally comprises a plug-retaining device. In one aspect, the plug-retaining device is a tubular member having a fluid channel therein. The plug-retaining device also has a first end, a second end, and a wall therebetween. When the plug-dropping container is in its plug-retained position, the plug-retaining device is oriented such that the wall of the plug-retaining device blocks the downward flow of the dart. In this position, the dart prohibits the flow of fluid through the canister; instead, fluid travels around the canister and through the canister annulus.

At the point at which plug-release is desired, the canister is raised within the housing. In one aspect of the assembly of the present invention, this is accomplished by rotating the plug-retaining device. The plug-retaining device is rotatable between a plug-retained position and a plug-released position. In the plug-retained position, the plug-retaining device is turned such that it blocks the canister channel and prevents dropping of the plug. Blocking the canister channel causes fluid entering the housing to flow around the canister via the bypass gap. To release the plug, the plug-retaining device is rotated by turning one or more shafts connected thereto. Rotation of the shaft causes the canister to move up axially and to approach the bore of the head member, thereby closing off the bypass gap and directing fluid to flow directly into the channel of the canister. Turning the plug-retaining device to the plug-released position also causes the plug-retaining device channel to be in fluid communication with the canister channel. The plug-retaining device channel can then receive the plug, whereupon the plug is

released into the wellbore. The plug-retaining device is then in position to receive both the dart and fluid flowing through the cementing head.

In another embodiment, one or more plug-dropping containers of the present invention may be stacked for sequential release of more than one plug in a cementing operation.

Some preferred embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1A is a partial schematic view of a plug-dropping container in its plug-retained position;

Figure 1B is a partial schematic view of the plug-dropping container of Figure 1A in its plug-released position, allowing the plug to be released down into the wellbore;

Figure 2A is a partial schematic view of an alternative embodiment of a plug-dropping container, showing two plug-dropping containers stacked one on top of another, both plug-dropping containers being in the plug-retained position;

Figure 2B is a partial schematic view of the plug-dropping container of Figure 2A following release of a plug from the lower plug-dropping container; and

Figure 2C is a partial schematic view of the plug-dropping container of Figure 2A following release of plugs into the wellbore from both stacked plug-dropping containers.

Figure 1A is a partial schematic view showing one aspect of the plug-dropping container **2** of the present invention. The plug-dropping container **2** is shown with a dart **8** disposed therein. The plug-dropping container **2** includes a tubular housing **10** connected at its upper and lower ends to a head member **4** by threads **12**. The head member **4** is part of a fluid circulation system such as a conventional cementing head.

The upper and lower ends of the tubular housing **10** have openings **13** and **15** for fluid communication with the upper bore **6** in the head member **4**.

Disposed generally co-axially within the housing **10** is a canister **30**. The canister **30** is a tubular shaped member which resides within the tubular housing **10** of the plug-dropping container **2**. This means that the outer diameter of the canister **30** is less than the inner diameter of the housing **10**. At the same time, the inner diameter of the canister **30** is configured to generally match the inner diameter of the bore **6**. As with the housing **10**, the canister **30** has a top opening and a bottom opening. A channel **35** is formed axially in the canister **30**. The channel is configured to closely receive and retain the dart **8** when the plug-dropping container **2** is in its plug-retained position.

The canister **30** is movable axially within the housing **10**. In order to accommodate this movement, the length of the canister **30** is less than the length of the surrounding housing **10**. The canister **30** is lowered and raised in order to move the canister **30** between a bypass open position and a bypass closed position.

Figure 1A presents the canister **30** in its bypass open position. In the bypass open position, the top opening of the canister **30** is below the bore **6** of the head member **4**, leaving a bypass gap **16** above the canister **30**. The bypass gap **16** creates a bypass area for fluid being injected from the head member **4** into the lower bore **18**. While **FIG. 1A** presents a bypass area formed by a shortened canister **30**, it is understood that other arrangements for a bypass area may be employed, such as the use of ports (not shown) which are selectively exposed when the canister 30 is in its lowered position within the surrounding housing **10**.

The canister **30** may be raised in order to close the bypass gap **16**, thereby closing off the bypass flow of fluid. In this bypass-closed position, the top opening of the canister **30** approaches the bore **6** of the head member **4**. This effectively shuts off the bypass area **16** above the canister **30**. In the arrangement shown in **FIG. 1A**, the top opening of the canister **30** is designed to approach a seat **14** when the canister **30** is raised. The seat

14 is disposed proximal to the lower portion of the bore 6 for approximately contacting the canister 30. The seat 14 can be disposed either at the bottom of the bore 6, or at the upper end of the tubular housing 10.

The canister 30 is generally aligned within the tubular housing 10. Preferably, the canister 30 is centralized within the tubular housing 10 by spacers 20 positioned between the outer wall of the canister 30 and the inner wall of the housing 10. The spacers 20 are preferably attached to the outer wall of the canister 30 and travel with the canister 30 as the canister 30 is raised or lowered. Alternatively, the spacers 20 may be attached to the inside of the tubular housing 10 so that the canister 30 moves axially relative to the spacers 20.

In order to move the canister 30 between its bypass-flow state (the bypass-open position) to its open-flow state (the bypass-closed position), a diverting mechanism 40 is provided. In the arrangement shown in FIGS. 1A and 1B, the diverting mechanism 40 is a tubular body disposed below the canister 30. As will be discussed below, rotation of the diverting mechanism 40 serves to selectively raise and lower the canister 30 within the surrounding housing 10.

The plug-dropping container 2 of the present invention further comprises a plug-retaining device 40. In the arrangement of FIGS. 1A and 1B, the diverting mechanism 40, also serves as the plug-retaining device 40. The plug-retaining device 40 has a first end, a second end, and a wall 44 therebetween. The plug-retaining device 40 also has a bore therein which serves as a fluid channel 45. When the plug-dropping container 2 is in its plug-retained position, the plug-retaining device 40 is oriented such that the wall 44 of the plug-retaining device 40 blocks the downward flow of the dart 8. In this position, the dart 8, in turn, prohibits the flow of fluid from the bore 6 of the head member 4 and through the canister 30. Instead, fluid travels around the canister 30, via the bypass area 16 and through the canister annulus.

The plug-retaining device **40** is rotatable within the tubular housing **10** by a pivoting connection **46**. In **FIG. 1A**, the pivoting connection **46** defines a shaft **46** that extends through the tubular housing **10** perpendicular to the channel **35**. The shaft 46 is rotated to move the plug-retaining device 40 from the plug-retained position to the plug-released position.

In the embodiment of **FIG. 1A**, rotation of the plug-retaining device **40** also serves to raise or lower the canister **30**. To effectively move the canister **30** axially, the distance from one end of the plug-retaining device **40** to the shaft **46** is greater than the distance from the wall **44** of the plug-retaining device **40** to the shaft **46**. Having one end of the plug-retaining device **40** longer than the distance to the wall **44** of the plug-retaining device **40** allows the plug-retaining device **40** to selectively raise or lower the canister **30** when the plug-retaining device **40** is rotated approximately **90** degrees. Preferably, the plug-retaining device **40** has rounded corners to facilitate rotation and respective axial movement of the canister **30**. Thus, movement of the plug-retaining device 40 from the plug-retained position to the plug-released position also moves the canister 30 from its bypass-flow state to its open-flow state.

It is to be understood that any means for moving the canister **30** from its lower position to its upper position is within the scope of the present invention. Other diverting mechanisms may be used for manipulating the canister **30**, such as a cam, a gear driver, a flapper valve and a plate (all not shown). However, the novel employment of a tubular plug-retaining device **40** as shown in **FIGS. 1A** and **1B** avoids the use of a separate actuating mechanism.

In **Figure 1A**, the plug-dropping container **2** is in the plug-retained position. In this position, the plug-retaining device / diverting mechanism **40** is oriented so that the wall **44** is in contact with the canister **30** . This serves to effectively retain the plug **8** within the canister **30**. In **Figure 1B**, the plug-dropping container **2** is in the plug-released position. In this position, the plug-retaining device / diverting mechanism **40** is rotated so that the channel **45** may receive both the dart **8** and fluid from the canister **30**. In the

plug-released position, the channel **35** of the canister **30** is in general alignment with the channel **45** of the plug-retaining device / diverting mechanism **40**. This allows the plug **8** to be easily released. As shown in **FIG. 1B**, the plug-retaining device channel **45** has approximately the same diameter as the canister channel **35**.

It is preferred that a shaft **46** extending on opposite sides of the plug-retaining device **40** be used to connect the plug-retaining device **40** to the tubular housing **10**. The shaft **46** may be rotated manually or be power-driven. It is understood, however, that any connection between the housing **10** and the plug-retaining device **40** is within the scope of the present invention.

In the plug-retained position, shown in **Figure 1A**, the plug-retaining device **40** is positioned so that the canister **30** rests on a wall **44** of the plug-retaining device **40**. In this position, the plug-retaining device channel **45** is perpendicular to, and not in fluid communication, with the canister channel **35**. The path of the plug **45** is blocked so that it cannot exit the canister **30**. In the preferred embodiment, the wall **44** of the plug-retaining device **40** is flat in configuration. This aids in obtaining a fluid seal when the plug-retaining device **40** is in its closed position, shown in **FIG. 1A**.

The canister **30** is in a lowered position when it rests on the wall **44** of the plug-retaining device **40**. Because the lower opening of the canister channel **35** is blocked off, fluid entering the tubular housing **10** from the upper opening **13** must generally flow around the canister **30** to exit at the lower opening **15** at the bottom of the tubular housing **10**. Visible in **FIG. 1A** is the bypass gap **16** between the canister **30** and the seat **14** enabling fluid to flow around the canister **30**. In this position, plug **8** retention is achieved.

When the plug **8** is ready for release, the plug-retaining device **40** is rotated to the second, or open, position, illustrated in **Figure 1B**. The rotation axially aligns the plug-retaining device channel **45** with the canister channel **35** for fluid communication. The rotation also causes the canister **30** to move up axially and approach the bore **6** of the

head member **4**. The canister **30** moves up because the distance from one end of the plug-retaining device **40** to the shaft **46** is greater than the distance from the wall **44** of the plug-retaining device **40** to the shaft **46**. As the top opening of the canister **30** approaches the seat **14**, the bypass gap **16** is substantially shut off. Fluid is thereby redirected to flow directly through the canister channel **35** and the plug-retaining device channel **45**. A combination of fluid flow and gravity releases the plug **8** into the lower bore **18**. However, it is within the scope of this invention to release the plug directly into the wellbore (not shown).

In many cementing operations, two plugs are released. In order to accommodate the release of two plugs, an alternative embodiment of the plug container is provided. An alternative embodiment is shown in **Figure 2A**.

In operation, two tools **102, 202** as described above are disposed below the head member **4**, and stacked on top of one another. As illustrated in **Figure 2A**, the tools **102, 202** are initially in the plug-retained position. Drilling fluid, or other circulating fluid, is introduced into the upper portion of a tubular housing **110** through a bore **6'** and an upper opening **113** of the tubular housing **110**. The fluid generally flows around an upper canister **130** through an upper bypass **116**, and exits a lower opening **115** of the lower portion of the tubular housing **110**. The fluid then flows through a lower bypass **216**, and a lower opening **215** of the lower portion of the tubular housing **210**. From there, the fluid exits into a lower bore **6''**, which may be a bore in the cementing head or may be the wellbore itself. In one aspect of the present invention, the lower bore **6''** defines the upper portion of the wellbore.

A bottom plug **208** is disposed in the lower canister **230** to be released into the wellbore. The bottom plug **208** may be used to clean the drill string or other piping of drilling fluid and to separate the cement from the drilling fluid. Release of the bottom plug **208** is illustrated in **Figure 2B**. To release the bottom plug **208**, the plug-retaining device **240** of the lower portion of the tubular housing **210** is rotated by turning a shaft **246** connected to the plug-retaining device **240**. The plug-retaining device **240** is rotated to

align a plug-retaining device channel **245** with the canister channel **235** for fluid communication. In this manner, the plug-retaining device **240** is moved from a plug-retained position to a plug-released position such that the wall **244** of the bottom plug-retaining device **240** no longer blocks downward travel of the bottom plug **208**. Rotation of shaft **246** also raises the lower canister **230** axially and moves the upper end of the lower canister **230** proximate to a seat **214** disposed above the lower canister **230**

Seating the lower canister **230** essentially seals off the lower bypass **216** and substantially redirects the fluid into the canister channel **235**. Cement flow and gravity release the bottom plug **208** into the wellbore.

The bottom plug **208** travels down the wellbore and wipes the drilling fluid from the drill string with its wipers. In one use, the bottom plug **208** is forced downhole by injection of cement until it contacts a wiper plug (not shown) previously placed in the top of a liner.

After a sufficient amount of cement is supplied to fill the annular space, the top plug **108** is released behind the cement. In this instance, drilling fluid is pumped in behind the top plug **108**. The top plug **108** separates the two fluids and cleans the drill string or other piping of cement. To release the top plug **108**, the plug-retaining device **140** of the upper portion of the tubular housing **110** is rotated to align the plug-retaining device channel **145** with the canister channel **135**, as illustrated in **Figure 2C**. In this manner, the plug-retaining device **140** is moved from a plug-retained position to a plug-released position such that the wall **144** of the top plug-retaining device **140** no longer blocks downward travel of the top plug **108**. The rotation raises the upper canister **130** into proximity with the lower end of the bore **6'** thereby substantially shutting off the upper bypass gap **116**. Drilling mud or other fluid is substantially directed into the canister channel **135** and forces the top plug **108** downward. The top plug **108** travels through the plug-retaining device channel **145** and the lower opening **115** of the upper tubular housing **110** and continues down through the canister channel **235**, and the plug-retaining device channel **245** of the lower portion of the tubular housing **210**. The top

plug **108** exits into the lower bore **6''** and continues into the wellbore with the drilling mud immediately behind it.

While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow. In this respect, it is within the scope of the present invention to use the plug containers disclosed herein to place plugs for various cleaning and fluid circulation procedures in addition to cementing operations for liners. In addition, the plug-dropping container of the present invention has utility in the context of deploying darts or plugs for the purpose of initiating subsea release of wiper plugs. It is further within the scope of the present invention to utilize the plug-dropping container disclosed herein for dropping items in addition to drill pipe darts and other plugs. Examples include, but are not limited to, balls and downhole bombs.

CLAIMS:

1. A plug-dropping container for releasing an object into a wellbore, the plug-dropping container comprising:

a tubular housing;

a canister disposed within and generally aligned with said tubular housing so as to define an annulus between said tubular housing and said canister, said canister being movable axially within said housing from a lower position to an upper position;

a channel within said canister, said canister channel being configured to receive the object therein;

a bypass proximate to the top end of said canister for permitting fluid to flow into said annulus when said canister is in its lower, bypass-open position, said bypass being substantially shut off when said canister is raised to its upper, bypass-closed position within said housing;

a plug-retaining device disposed within said tubular housing below said canister, said plug-retaining device having a first end, a second end, and a wall therebetween;

a channel within said plug-retaining device for placing said first and second ends of said plug-retaining device in fluid communication;

and wherein said plug-retaining device is movable from an object-retained position to an object-released position, such that said wall of said plug-retaining device substantially blocks the object from exiting said canister when said plug-retaining device is in its object-retained position, and said channel of said plug-retaining device is in substantial alignment with said channel of said canister when said plug-retaining device is in its object-released position, thereby permitting the object to exit said canister and to travel downward through said channel of said plug-retaining device.

2. A plug-dropping container as claimed in claim 1, wherein said canister further comprises a top opening and a bottom opening.

3. A plug-dropping container as claimed in claim 1 or 2, wherein said tubular housing comprises a top opening and a bottom opening, and wherein said housing is in fluid communication with a bore in a head member.

4. A plug-dropping container as claimed in claim 3, wherein said bypass is between the top opening of said canister, and the bore of the head member.

5. A plug-dropping container as claimed in claim 3 or 4, wherein the head member is a cementing head.

6. A plug-dropping container as claimed in any preceding claim, wherein said object is a plug.

7. A plug-dropping container as claimed in claim 6, wherein said plug is a dart.

8. A plug-dropping container as claimed in any of claims 1 to 5, wherein said object is a ball.

9. A plug-dropping container as claimed in any of claims 1 to 5, wherein said object is a bomb.

10. A plug-dropping container as claimed in any preceding claim, wherein said plug-retaining device is moved from its object-retained position to its object-released position by rotating said plug-retaining device.

11. A plug-dropping container as claimed in claim 10, wherein said plug-retaining device is moved from its object-retained position to its object-released position by rotating said plug-retaining device approximately 90 degrees.

12. A plug-dropping container as claimed in claim 10 or 11, wherein rotation of said plug-retaining device from its object-retained position to its object-released position

further serves to move said canister from its bypass-open position to its bypass-closed position.

13. A plug-dropping container as claimed in claim 10, 11 or 12, wherein rotation of said plug-retaining device is via a pivoting connection; and

wherein the distance from one end of the plug-retaining device to said pivoting connection is greater than the distance from said wall of said plug-retaining device to said pivoting connection.

14. A plug-dropping container as claimed in claim 13, wherein said pivoting connection comprises a shaft about which said plug-retaining device is rotated between its object-retained position and its object-released position.

15. A plug-dropping container as claimed in any preceding claim, wherein said channel of said plug-retaining device is in generally axial alignment with the wellbore when said channel of said plug-retaining device is in its open position, thereby providing a channel through which the object can enter the wellbore.

16. A plug-dropping container as claimed in any preceding claim, further comprising at least one spacer disposed between said housing and said canister for essentially centralizing said canister within said housing.

17. A plug-dropping container as claimed in any preceding claim, further comprising a seat above said canister and in contact with the bore of the head member.

18. A cementing head having a plug-dropping container as claimed in any preceding claim for releasing a plug into a wellbore during a cementing operation, the cementing head having a bore therein for receiving fluids,

wherein the tubular housing is in fluid communication with the bore in the cementing head;

and wherein the plug-dropping container further comprises at least one pivoting connection for rotating said plug-retaining device from its object-retained position to its object-released position.

19. A plug-dropping container for dispensing plugs into a wellbore during a cementing operation, the plug-dropping container being connected to a cementing head having a bore therein for receiving fluids, the plug-dropping container, comprising:

a tubular housing having a top opening and a bottom opening, said housing being in fluid communication with the bore in the cementing head;

an upper canister disposed within and generally aligned with said housing so as to define an annulus between said tubular housing and said upper canister, said upper canister also having a top opening and a bottom opening, and said upper canister being movable axially within said housing from a lower position to an upper position;

a channel within said upper canister, said channel of said upper canister being configured to receive a top plug therein;

an upper bypass between said top opening of said upper canister, and the bore for permitting fluid to flow into said annulus when said upper canister is in its lower position, said upper bypass being substantially shut off when said upper canister is raised to its upper position within said housing;

an upper plug-retaining device disposed within said housing below said bottom opening of said upper canister, said upper plug-retaining device having a first end, a second end, and a wall therebetween;

a channel within said upper plug-retaining device for placing said first and second ends of said first plug-retaining device in fluid communication;

a lower canister disposed within and generally aligned with said housing and below said upper plug-retaining device so as to define an annulus between said housing and said lower canister, said lower canister also having a top opening and a bottom opening, and said lower canister also being movable axially within said housing from a lower position to an upper position;

a channel within said lower canister, said channel of said lower canister being configured to receive a bottom plug therein;

a lower bypass between said top opening of said lower canister, and said upper plug-retaining device;

a lower plug-retaining device disposed within said housing below said bottom opening of said lower canister, said lower plug-retaining device having a first end, a second end, and a wall therebetween;

a channel within said lower plug-retaining device for placing said first and second ends of said lower plug-retaining device in fluid communication;

said lower plug-retaining device rotating between a plug-retained position and a plug-released position, such that said wall of said lower plug-retaining device substantially blocks the bottom plug from exiting said lower canister when said lower plug-retaining device is in its plug-retained position, and said channel of said lower plug-retaining device is in substantial alignment with said channel of said lower canister when said lower plug-retaining device is in its plug-released position, thereby permitting the bottom plug to exit said lower canister and to travel downward through said channel of said lower plug-retaining device; and

said upper plug-retaining device rotating between a plug-retained position and a plug-released position, such that said wall of said upper plug-retaining device substantially blocks the top plug from exiting said upper canister when said upper plug-retaining device is in its plug-retained position, and said channel of said upper plug-retaining device is in substantial alignment with said channel of said upper canister when said upper plug-retaining device is in its plug-released position, thereby permitting the top plug to exit said upper canister and to travel downward through said channel of said upper plug-retaining device.

20. A plug-dropping container as claimed in claim 19, wherein said lower plug-retaining device and said upper plug-retaining device each rotate about a respective pivoting connection.

21. A plug-dropping container as claimed in claim 20, wherein said pivoting connection comprises at least one gear.

22. A plug-dropping container within a head member for releasing a plug into a wellbore, the plug-dropping container, comprising:

a tubular housing;

a canister disposed within and generally aligned with said tubular housing so as to define an annulus between said tubular housing and said canister, said canister having a top end and a bottom end, and said canister being movable axially within said housing from a lower position to an upper position in order to move said canister from its bypass-flow position to its open-flow position;

a channel within said canister, said canister channel being configured to receive the plug therein;

a bypass proximate to the top end of said canister for permitting fluid to flow into said annulus when said canister is in its lower position, said bypass being substantially shut off when said canister is raised to its upper position within said housing;

a diverting mechanism that forces said canister to move from its bypass-open position to its open-flow position; and

a plug-retaining device disposed below said canister, said plug-retaining device selectively movable from a plug-retained position wherein the plug is restricted from exiting said tubular housing, to a plug-released position wherein the plug may exit said tubular housing.

23. A plug-dropping container as claimed in claim 22, wherein said plug-retaining device also functions as said diverting mechanism.

24. A plug-dropping container within a head member for releasing a plug into a wellbore, the plug-dropping container comprising:

a tubular housing;

a canister disposed within and generally aligned with said tubular housing so as to define an annulus between said tubular housing and said canister, said canister being movable axially within said housing in order to move said canister between a bypass-open position and a bypass-closed position;

a channel within said canister, said canister channel being configured to receive the plug therein;

a bypass at an end of said canister for permitting fluid to flow through said annulus when said canister is in its bypass-open position, said bypass being substantially shut off when said canister is moved to its bypass-closed position within said housing;

a plug-retaining device disposed below said canister, said plug-retaining device selectively movable from a plug-retained position wherein the plug is restricted from exiting said tubular housing, to a plug-released position wherein the plug may exit said tubular housing; and

a diverting mechanism that forces said canister to move from its bypass-open position to its bypass-closed position.

25. A plug-dropping container as claimed in claim 24, wherein said plug-retaining device also functions as said diverting mechanism.

26. A plug-dropping container as claimed in claim 25, wherein said plug-retaining device comprises a flapper whose movement is mechanically linked to said canister.

27. A plug-dropping container as claimed in claim 25, wherein said plug-retaining device comprises a horizontal plate whose movement is mechanically linked to said canister.

28. A plug-dropping container as claimed in claim 25,

wherein said plug-retaining device comprises an elongated body having a bore, the body being rotatable so as to selectively rotate said bore into and out of alignment with said canister, and whose rotation forces movement of said canister; and

wherein rotation of said plug-retaining device serves to move said canister between its bypass-open position and its bypass-closed position.

29. A plug-dropping container as claimed in any of claims 24 to 28, wherein said diverting mechanism comprises at least one cam.

30. A plug-dropping container as claimed in any of claims 24 to 29, wherein said diverting mechanism comprises at least one gear.

31. A plug-dropping container within a head member for releasing a plug into a wellbore, the plug-dropping container, comprising:

a tubular housing;

a canister disposed within and generally aligned with said tubular housing so as to define an annulus between said tubular housing and said canister;

a channel within said canister, said canister channel being configured to receive the plug therein;

said canister being movable rotationally about the axis of said channel in order to rotate said canister from a bypass-open position to a bypass-closed position;

one or more ports in said canister for permitting fluid to flow through said annulus when said canister is in its bypass-open position, said bypass being substantially shut off when said canister is rotated to its bypass-closed position;

a plug-retaining device disposed below said canister, said plug-retaining device selectively movable from a plug-retained position wherein the plug is restricted from exiting said tubular housing, to a plug-released position wherein the plug may exit said tubular housing; and

a diverting mechanism that forces said rotational movement of said canister.

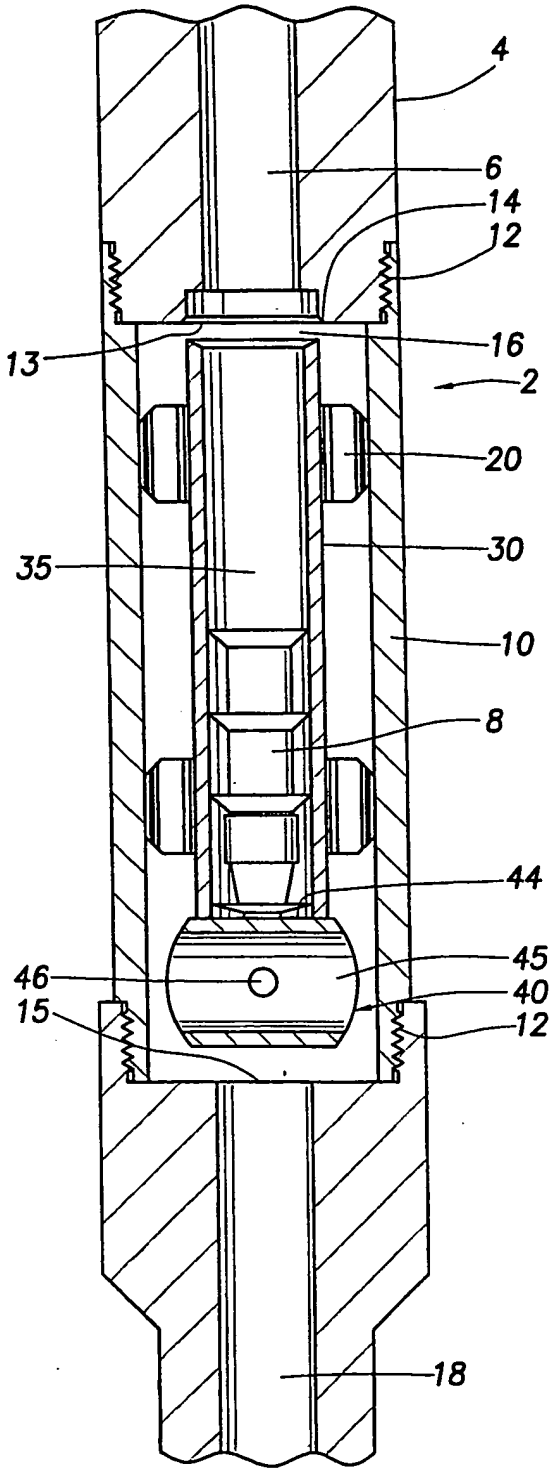
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FIG. 1A

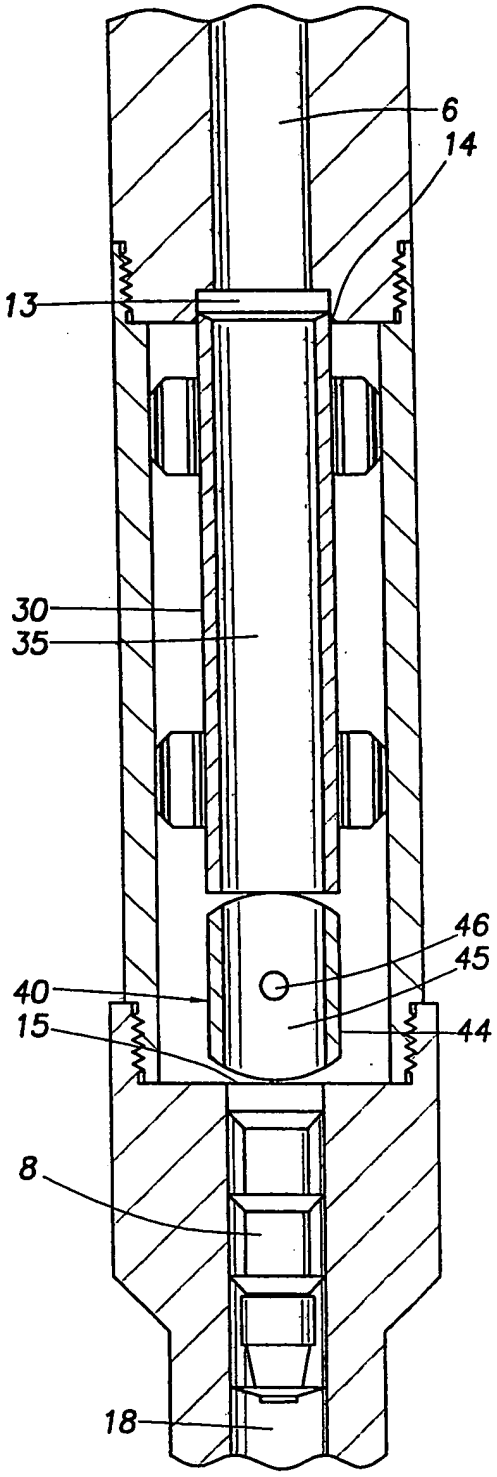
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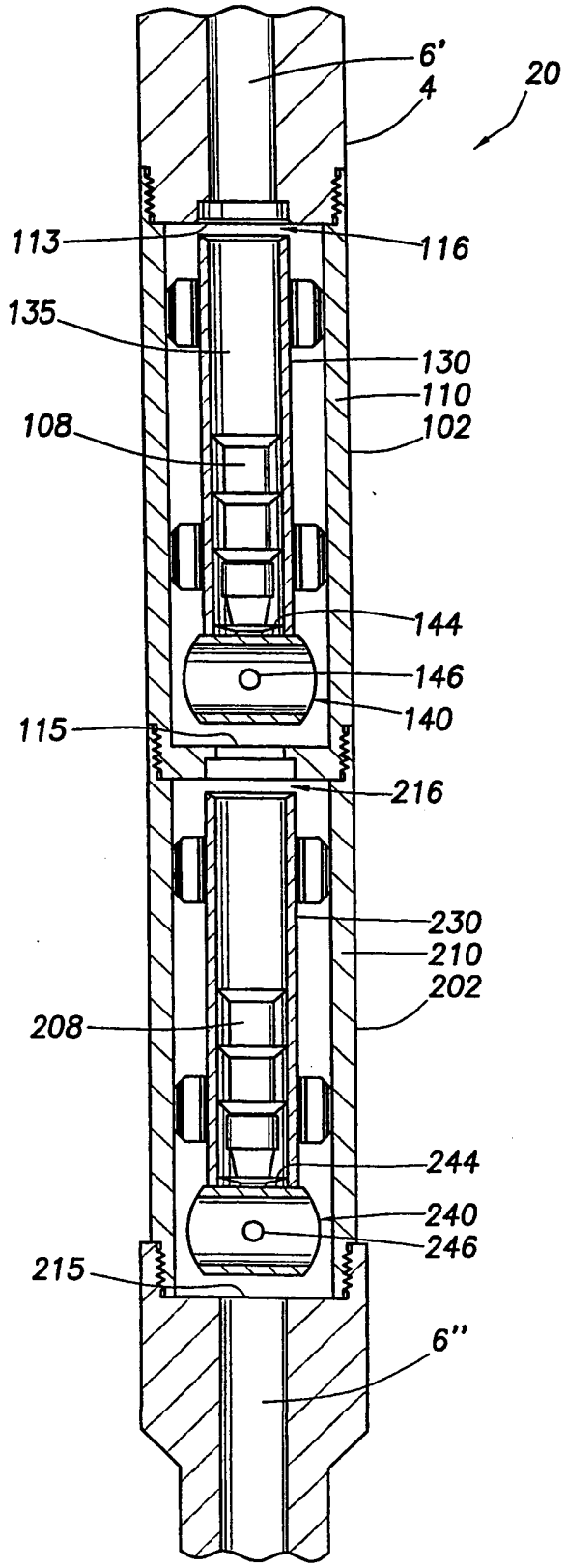
FIG. 1B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113
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FIG.2A

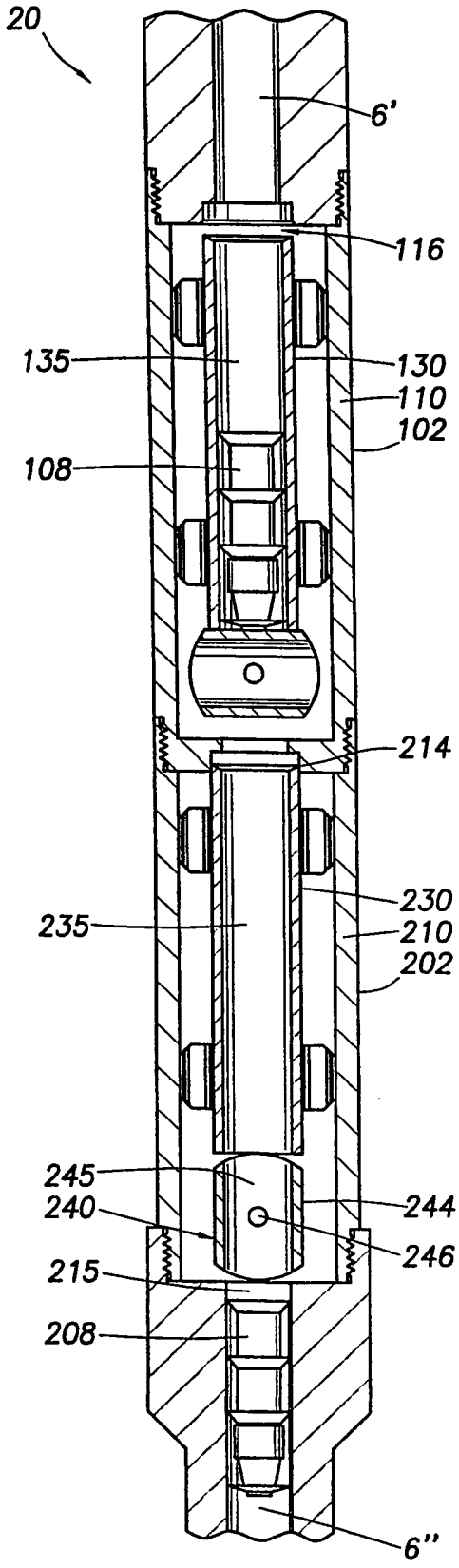
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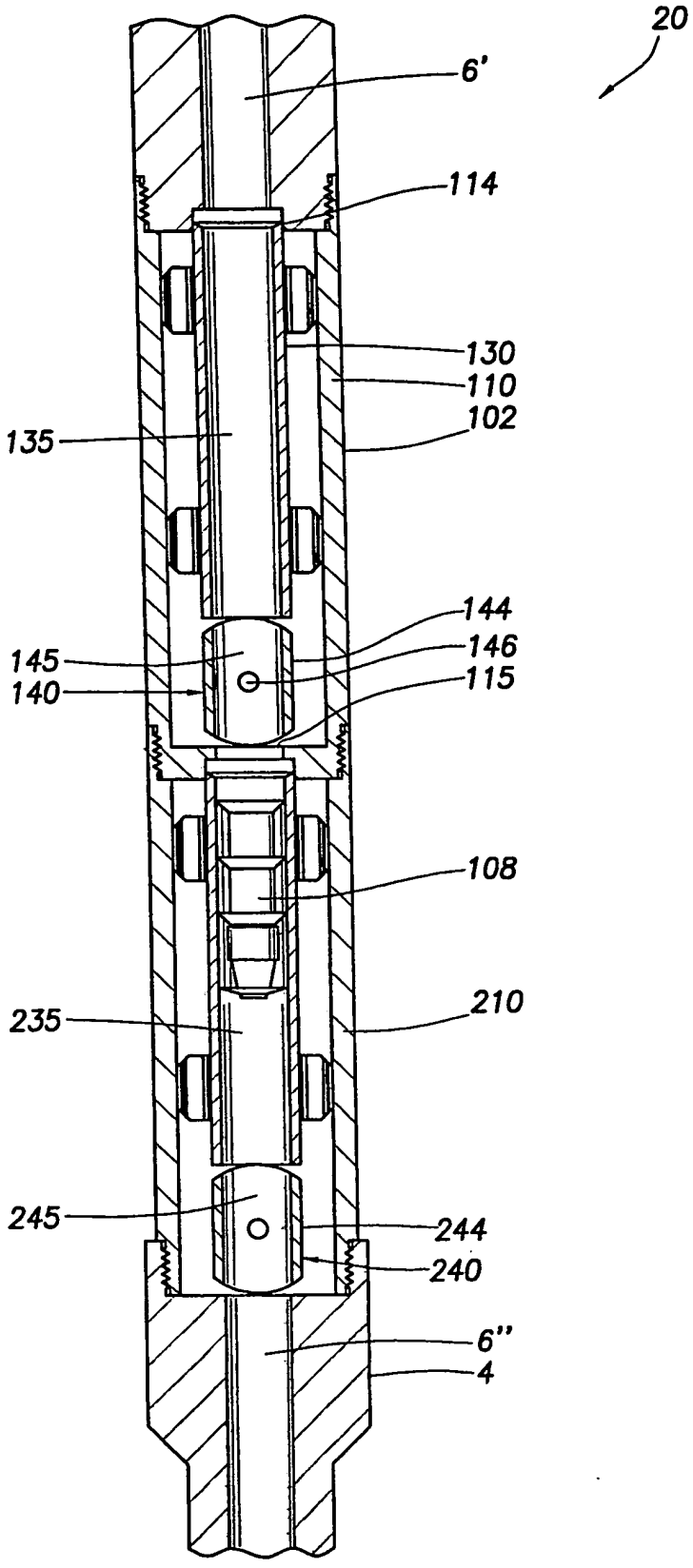
FIG.2B

FIG.2C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INTERNATIONAL SEARCH REPORT

Internat I Application No
PCT/GB 03/00307

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B33/05

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 444 928 A (PITTS CHARLES A) 20 May 1969 (1969-05-20) column 1, line 43 - line 51	24,25,28
Y	column 2, line 43 - line 69	26,27,30
A	figures 1,2	1-23,31
X	US 5 960 881 A (VANDERVORT KURT D ET AL) 5 October 1999 (1999-10-05) column 8, line 1 - line 17	24,25,29
A	column 9, line 31 - line 49; figures 2,5-7	1-23, 26-28, 30,31
Y	US 5 833 002 A (HOLCOMBE MICHAEL W) 10 November 1998 (1998-11-10) column 3, line 30 - line 53	26,30
A	column 4, line 53 - line 55; figures 1,2A,2B,8	1-23,31

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 May 2003	21/05/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bellingacci, F

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	paragraph '0038!; figure 2	1-26, 28-31
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